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VONSENITE. A PRELIMINARY NOTE ON A NEW MINERAL

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Specimens of a coal-black, lustrous mineral were collected at Riverside, California, by Mr. M. Vonsen of Petaluma. His determinations with the blowpipe gave reactions for the rare mineral ludwigite, but the structure and appearance of his mineral were so unlike all known ludwigites that a further investigation seemed necessary to establish its true identity.

The occurrence is in the form of a large boulder-shaped mass directly on a contact between limestone and granite. The massive mineral resembles and merges into magnetite, and probably has been overlooked because of the assumption that it was that mineral. Chlorite, green pyroxene and thin plates of a white talcose mineral occur associated.

The color of the mineral is black and the streak and powder is brownish black. The luster is brilliant metallic, and the smooth faces occasionally show an iridescence. It is very brittle and breaks with a slight conchoidal fracture. No definite cleavage direction could be observed, but there is a tendency to part normal to the prismatic zone. H. = 5; G. = 4.21. The mineral is perfectly opaque in thin sections, and is non-magnetic.

Crystallography.—The structure is granular massive, forming compact and friable masses. Imperfectly formed individual crystals can be obtained from the friable masses, especially where in contact with the seams of chloritic material. The crystals are short prisms and sometimes have the four faces of the unit prism complete, but most of them are very imperfectly formed. Excellent reflections can be obtained from the prismatic faces but the terminating faces were missing on all the crystals examined; it is consequently not definitely established whether the mineral is orthorhombic or monoclinic, altho the horizontal parting indicates it to be orthorhombic.

Several of the crystals were measured with the reflecting goniometer, giving good sharp readings. The prism which is common to all, and which predominates, is taken as the unit prism, giving the partial axial ratio: $a : b : c = 0.7558 : 1 : ?$

Forms and measurements:

b(010), *m*(110), *l*(210), *n*(140), *x*(160).

	Measured	Calculated
$110 : 1\bar{1}0$	74°10′	— —
110 : 010	52 53	52 55
110 : 210	16 35	16 23
110 : 140	34 37	34 37
010 : 160	12 11	12 26

Composition.—The average composition of the material thus far studied proved to be:

	%	Ratio
FeO	39.75	0.552
MgO	10.71	0.268
B_2O_3	14.12	0.202
Fe_2O_3	34.82	0.218
	99.40	

This ratio corresponds to the ludwigite formula, $3(Fe, Mg)O.B_2O_3 + FeO.Fe_2O_3$ in which the ratio of Fe : Mg, in the borate, is near 5 : 4; the calculated composition on this basis is:

FeO 40.39, MgO 11.22, B_2O_3 14.73, Fe_2O_3 33.66, sum 100.00%

The analyses yielding the above average were generally made from different samples, which were hand picked, in order to get the purest possible material. They indicated that a variation possibly existed in the amount of MgO present, since duplicate analyses of one sample gave 7.43 and 7.79 percent. MgO, while other samples varied between 9.26 and 11.51 percent. The low MgO result was attributed to its precipitation with the iron, as the Fe_2O_3 determined by weight was about 4 percent. higher than that given by volumetric determination. Whether this variation exists, and whether the amount of B_2O_3 also varies, has not been definitely determined.

The mineral fuses at 3 to a black magnetic globule. It is completely soluble in HCl and H_2SO_4. The HCl solution gives a strong borate reaction with turmeric paper, altho the green boron flame is difficult to obtain.

The analyses of ludwigite from Hungary by Ludwig and Sipöcz and from Montana by Schaller show it to be essentially a magnesium borate plus the magnetite molecule, with part of the magnesium replaced by a subordinate amount of ferrous iron. The Riverside mineral, however, is essentially a ferrous borate plus the magnetite molecule with part of its iron replaced by a subordinate amount of magnesia. Its distinctive difference in composition, and its manifest difference in structural and optical characters from ludwigite, justifies the writer in proposing the new name *vonsenite*, after its discoverer, for the mineral.

THE GOLDSCHMIDT TWO-CIRCLE METHOD. CALCULATIONS IN THE HEXAGONAL SYSTEM

CHARLES PALACHE

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FORMS AND SYMBOLS

The gnomonic projection of a hexagonal crystal presents a grouping of face-poles of hexagonal or trigonal pattern. The axes of reference used to determine the symbols may be either of two sets of lines; each set intersects mutually at 60 degrees; the two sets are turned to each other 30 (or 90) degrees. Symbols and axial ratio may be determined from either set, and may later be transformed to accord with a choice of the other. The determination as to which set is to be used in a given case is somewhat arbitrary, and the dual choice introduces some confusion in the study of this system.

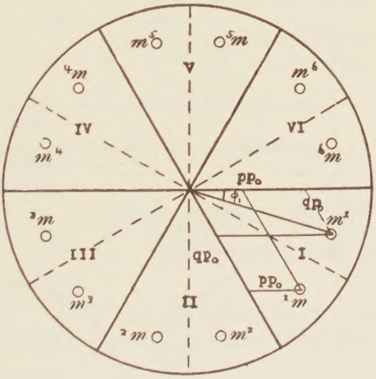

FIG. 27

In figure 27 the two sets of axes are shown by heavy and dotted lines; there is also shown the numbering of the sectants and the method of indicating by exponents the position of a face (m) on the crystal. In the holohedral crystals all sectants are identical. For two faces the coördinates are shown in the figure, and the Goldschmidt symbol is derived as in the systems with rectangular axes, by measuring along any two adjacent axes the coördinate lengths which fix the position of the face-pole.

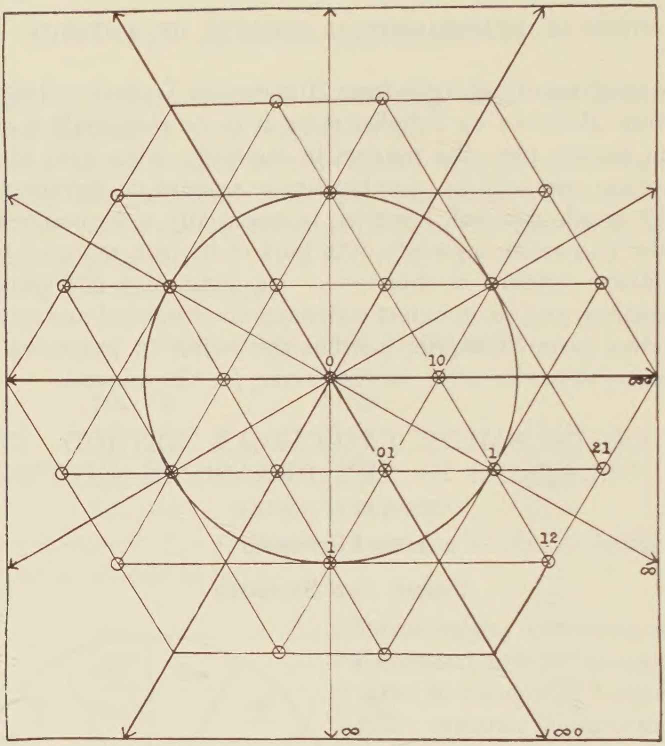

Fig. 28

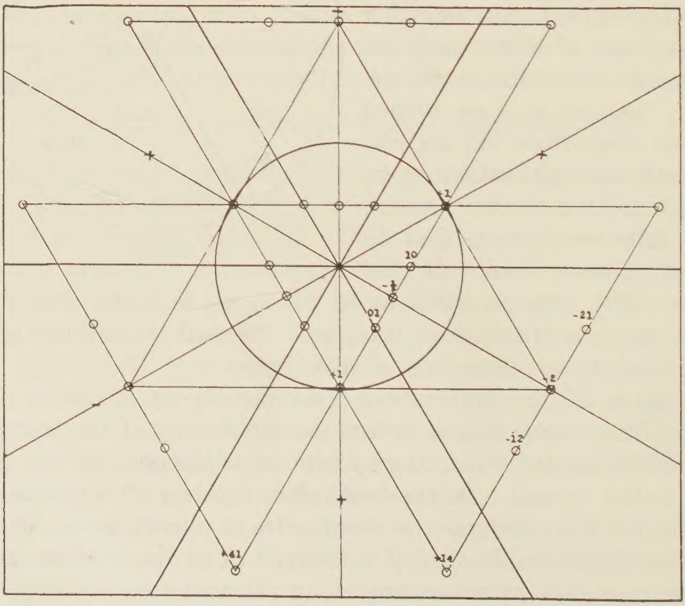

Fig. 29

For m^1 the coördinates are pp_0 and qp_0; for ${}^1m$, qp_0 and pp_0.

Since p_0, the element of a given species, is common to all symbols, the values p and q, whole numbers or fractions, indicate the position of the face-pole and constitute the symbol. This symbol, pq, gives directly the Bravais-Miller symbol ordinarily used for this system, thru the following equation:

$$pq = (p.q.\overline{p+q}.1)$$

For example: $21 = (2.1.\bar{3}.1.)$ $\quad 10 = (1.0.\bar{1}.1)$

$\frac{1}{2}1 = (1.2.\bar{3}.2)$ $\quad 11 = (1.1.\bar{2}.1)$

In figure 28 is shown a projection of beryl with one of each of the seven types of forms of the hexagonal system, which receive the following symbols and occupy the given positions in the Goldschmidt system:

	Gdt. (G_1)	Bravais	Position of Face-pole
Basal Pinacoid........	0	0001	Center of coördinates.
Prism, 1st Order.......	$\infty 0$	$10\bar{1}0$	In the direction of face 10 or of the coördinate axes.
Prism, 2nd Order......	∞	$11\bar{2}0$	In the direction of face 1 or of the intermediate axes.
Pyramid, 1st Order....	p0	$p0\bar{p}1$	On coördinate axes.
	e.g. 10	$10\bar{1}1$	
Pyramid, 2nd Order	p	$p.p.\bar{2}\bar{p}.1$	On intermediate axes.
	e.g. 1	$11\bar{2}1$	
	$\frac{1}{2}$	$11\bar{2}2$	
Dihexagonal Pyramid..	pq	$p.q.\overline{p+q}.1$	Any position between two sets of axes. 2 faces in each sectant.
	e.g. 21	$21\bar{3}1$	
	$\frac{2}{3}\ \frac{1}{3}$	$21\bar{3}3$	
Dihexagonal Prism.....	$\frac{p}{q}\infty$	$p.q.\overline{p+q}.0$	In the direction of face pq; 2 faces in each sectant.
	e.g. 2∞	$21\bar{3}0$	

This choice of axes is indicated in the *Winkeltabellen* by a symbol (G_1) placed after the axial ratio table at the head of each hexagonal mineral. It corresponds to a position of the crystal in which the second order pyramid ($11\bar{2}1$) is taken as unit form and is used chiefly for minerals of pronounced hexagonal habit such as apatite, beryl and quartz.

If c be the length of the vertical axis of a crystal as given, say, in Dana, then c_1, the length of the vertical axis in position G_1 is $\sqrt{3}c$.

$$p_0 = \frac{2}{3}c_1 = \frac{2}{\sqrt{3}}c \qquad c_1 = \frac{3}{2}p_0 \qquad c = \frac{\sqrt{3}}{2}p_0$$

Thus for quartz, $c = 1.09997$; $c_1 = \sqrt{3}\,c = 1.9051$; $p_0 = \frac{2}{3}c_1 = 1.2701$.

If the alternative set of axes be chosen (Position "G_2"), the Goldschmidt symbols are derived as before from the adjacent axes and have a similar form, but with a different value of p_0. In this case the pyramid of first order (or rhombohedron), $(10\bar{1}1)$, is taken as unit form and c_2 is equal to c.

$$p_0 = \tfrac{2}{3}c_2,\ c_2 = \tfrac{3}{2}p_0,\ p_0\,(G_1) = \sqrt{3}p_0(G_2).$$

Thus for calcite:—$c = c_2 = 0.8543$; $p_0 = \frac{2}{3}c_2 = 0.5695$.

The Goldschmidt symbol, pq, in position G_2, does not yield the correct Bravais symbol; it must first be transformed to the G_1 equivalent by means of the following transformation equation.

$$pq\ (G_2) = \frac{p+2q}{3} \cdot \frac{p-q}{3}\ (G_1).$$

For example:

G_2	G_1	Bravais
21	$\frac{4}{3}\ \frac{1}{3}$	$41\bar{5}3$
$2\frac{1}{2} = \frac{4}{2}\ \frac{1}{2}$	$\frac{2}{2}\ \frac{1}{2}$	$21\bar{3}1$
1 = 11	1 0	$10\bar{1}1$
10	$\frac{1}{3}\ \frac{1}{3}$	$11\bar{2}3$

The position G_2 is generally adopted in the *Winkeltabellen* for crystals of rhombohedral symmetry. It should be noted that altho Goldschmidt regarded the requirement just stated in deriving Bravais symbols from G_2 symbols thruout the *Index der Krystallformen,* he abandoned it in the *Winkeltabellen,* where he derived the Bravais symbols directly from the G_2 symbols. Consequently the Bravais symbols given there for all minerals with the G_2 heading are not conformable to usage. In the later *Atlas der Krystallformen* both types of Bravais symbols are given, which helps to clear up the confusion.

The transformation equation for the reverse change of G_1 to G_2 symbols is as follows: $pq\ (G_1) = (p+2q)\cdot(p-q)\ (G_2)$.

For further discussion of the relation of the two positions, for proof of the various equations given above, and for transformation equations from Goldschmidt symbols to Miller, Naumann and other symbols, reference should be made to the Introduction of the *Index der Krystallformen,* pp. 29–36 and 44–53.

Figure 29 shows a few forms of a rhombohedral mineral (calcite) in gnomonic projection. The sectants are alternately positive and negative, II, IV and VI being +; I, III and V −.

This brings the unit positive rhombohedron of the crystal towards the front, the customary position. The positive or negative character of a form is indicated in Goldschmidt symbols by the appropriate sign placed before the symbol. In this figure as in figure 28 the value of p_0 is given graphically by the distance measured along the axis from the coördinate center to the face 10.

The further subdivision of the sectants into right and left halves for a mineral of trirhombohedral symmetry is well shown in the gnomonic projection reproduced in a paper on willemite (G_2) by Palache and Graham.[1] The distribution of face-poles in the rhombohedral-trapezohedral symmetry type is shown in the splendid folio plate of quartz in Goldschmidt's *Atlas der Krystallographische Projectionsbilder*, Berlin, 1887. In the same atlas are numerous plates of rhombohedral minerals of varying habit.

CALCULATION OF THE ELEMENT, p_0, AND OF SYMBOLS.

A hexagonal crystal having been measured, it is projected by means of the v and h angles (Gnom. Proj., p. 70) and thus a graphic solution for the unknown values is obtained. The calculation follows only where the measurements are sufficiently good and numerous to insure increased accuracy in the results. From the plot or directly from the goniometer readings it will be evident that a number of the v angles differ from one another by almost exactly 30 degrees or some multiple (60°, 90°, 120°). The first meridian is to be placed at or near one of these readings, the exact value being obtained by averaging them. The G_1 or G_2 position is determined by the choice of either one of two of them, 30 degrees apart; the decision must be made by studying the habit of the crystal or by comparing the angles made by terminal faces with those given in the *Winkeltabellen* if the species of the crystal is known. For example, in a crystal of calcite the zero meridian will be so chosen that one face of the cleavage rhombohedron will have a φ of $+ 90°$.

The position of v_0 having been established, it is subtracted from each v to obtain φ. In addition it is necessary to find for each face φ_1, which is the angle to the nearest axis or the difference between φ and the nearest multiple of 60 degrees; and also the value $(60° - \varphi_1)$. ρ for each face is also obtained by subtracting

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[1] *Am. J. Sci.*, **36**, 641, 1913.

h_0 from h. For an illustration of the form in which these calculations are made by Goldschmidt, reference is made to an article by him on vanadinite.[2]

In figure 30 is shown a gnomonic projection of a sectant of a hexagonal crystal with the angular relations of a face-pole, pq, whose angles φ_1 and ρ are known. From this figure, using the sine-law of plane trigonometry, we obtain the following relations:

$$\frac{pp_0}{\tan\rho} = \frac{\sin(60° - \varphi_1)}{\sin 60°}; \qquad \frac{qp_0}{\tan\rho} = \frac{\sin\varphi_1}{\sin 60°},$$

whence

$$pp_0 = \frac{\sin(60° - \varphi_1)\tan\rho}{\sin 60°}; \qquad qp_0 = \frac{\sin\varphi_1 \tan\rho}{\sin 60°}.$$

The formulas are simpler for the following special cases:

$$p0,\ \varphi_1 = 0\ ; \qquad pp_0 = \tan\rho; \qquad qp_0 = 0;$$

$$pp,\ \varphi_1 = 30°; \qquad pp_0 = qp_0 = \frac{\tan\rho}{\sqrt{3}}.$$

$$\text{Prisms: } \frac{p}{q}\infty; \qquad \frac{p}{q} = \frac{\sin(60° - \varphi_1)}{\sin\varphi_1}.$$

From the values for the coördinates of each face derived by the application of the above formulas the element p_0 can be obtained as an average value, using for p and q the values shown by the graphic solution. Or if p_0 is known, the exact values of p and q are to be found from the same coördinates.

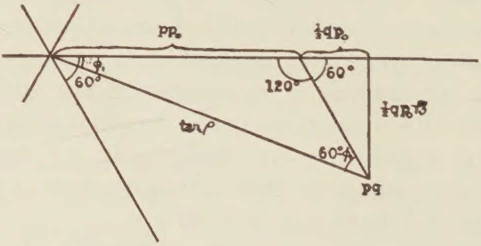

Fig. 30

Calculation of Angles φ and ρ from the Element p_0 and Symbols.

In figure 30, using the right-angled triangle, the following relations may be established:

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[2] *Z. Kryst. Min.*, **32**, 561, 1900.

$$\tan \varphi_1 = \frac{\frac{1}{2} q p_0 \sqrt{3}}{p p_0 + \frac{1}{2} q p_0} = \frac{q \sqrt{3}}{2p + q} = \frac{\sqrt{3}}{2n + 1} \quad \text{where } n = \frac{p}{q},$$

$$\tan^2 \rho = (p p_0 + \tfrac{1}{2} q p_0)^2 + (\tfrac{1}{2} q p_0 \sqrt{3})^2 = p_0^2 (p^2 + pq + q^2),$$

whence

$$\tan \varphi_1 = \frac{\sqrt{3}}{2n + 1} \text{ where } n = \frac{p}{q}; \quad \tan \rho = p_0 \sqrt{(p^2 + pq + q^2)}.$$

Since φ_1 is independent of p_0 the φ angles are alike for all hexagonal forms with like ratio of p to q. The values may be found for most cases from the table of page 25, *Winkeltabellen.* In the same way log tan ρ may be found for most forms from the tables of pages 22 and 23.

For example, to find φ and ρ for the scalenohedron $(21\bar{3}4)$ of calcite:

$$21\bar{3}4 = \tfrac{2}{4}\,\tfrac{1}{4}\,(G_1) = \tfrac{4}{4}\,\tfrac{1}{4}\,(G_2).$$

Winkeltabellen, p. 25: $p : q = 1 : 4, \ \varphi = 10° 53'$.
Winkeltabellen, p. 22: $\tan \rho = p_0 \tfrac{1}{4} \sqrt{16 + 4 + 1} = p_0 \tfrac{1}{4} \sqrt{21}$

$$\begin{array}{rl} \lg \tfrac{1}{4}\sqrt{21} & = 0.05905 \\ \text{calcite } p_0 = .5695 \ \lg p_0 & = \underline{9.75552} \\ \lg \tan \rho & = 9.81457 \qquad \rho = 33° \, 07' \end{array}$$

ILLUSTRATION OF THE HEXAGONAL SYSTEM. HEMATITE FROM NEW MEXICO.[1]

WILLIAM F. FOSHAG

U. S. National Museum

A specimen of hematite in the U. S. National Museum (Mus. No. 93761) from the western part of the San Augustine Plain, Socorro Co., New Mexico has been found to show some unusual features and seems worthy of a short description. The specimen consisted of a somewhat cellular quartz in which are embedded single hematite crystals of excellent development and lustrous faces. The hematite includes quartz and the two minerals were no doubt formed at the same time.

The crystals are thick tabular in habit and, due to the equal development of the + 1 and −1 rhombohedrons, have a hexagonal aspect. The trigonal character of the crystals is brought out, however, by concentric triangular markings on the base of

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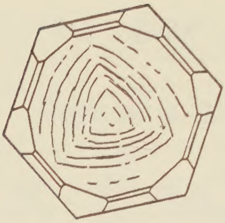
[1] Published with the permission of the Secretary of the Smithsonian Institution.



some of the crystals. These markings are not due to etching, but are connected with the growth of the crystals. They are not depressed, but slightly stepped and do not affect the brilliancy of the base. The sides of the triangles are parallel to +1 faces while the angles point toward −1. These markings are sketched on the orthographic projection shown (Fig. 31.). The forms present are 0(0001), ∞0 ($10\bar{1}0$), 10($10\bar{1}1$), 20($20\bar{2}1$), ±1($11\bar{2}1$). The signals were sharp and the deviations in the measurements from those given in Goldschmidt's tables and those of Melczer[1] are so slight, amounting to almost perfect agreement, that it is evident that this hematite is essentially pure and free from any great amount of FeO, TiO_2 or other constituents in solid solution.

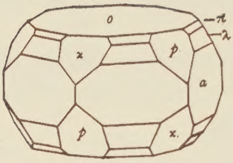


FIG. 31.

The zonal relations are brought out to better advantage in the hexagonal system, as well as in the other systems, with the Goldschmidt than the other symbols. Thus in the hematite measured, ∞0, 0, 10, 20, are in a zone, as shown by the common value for q (G_2), while the corresponding Bravais symbols $10\bar{1}0$, 0001, $10\bar{1}1$, $20\bar{2}1$, do not show this relation so well.

TABLE OF ANGLES OF HEMATITE

Form	G_1 Gdt.	G_2	Bravais		Measured		Calculated	
					φ	ρ	φ	ρ
0	0	0	0001	0001	—	0° 00′	—	0° 00′
a	∞	∞0	$11\bar{2}1$	$10\bar{1}0$	0° 00′	90 00	0° 00′	90 00
π	$\frac{1}{3}$ $\frac{1}{3}$	10	$11\bar{2}3$	$10\bar{1}1$	0 00	42 10	0 00	42 14
λ	$\frac{2}{3}$ $\frac{2}{3}$	20	$22\bar{4}3$	$20\bar{2}1$	0 00	61 8	0 00	61 10
px	1 0	±1	$10\bar{1}1$	$11\bar{2}1$	30 00	57 31	30 00	57 33

LISTS OF THE HEXAGONAL AND TRIGONAL MINERALS INCLUDED IN GOLDSCHMIDT'S WINKELTABELLEN. EDGAR T. WHERRY. Washington, D. C.—This list follows the plan used with tetragonal minerals, altho it has seemed best to separate the hexagonal from the trigonal classes. In the event of the axial ratio obtained on an unknown crystal not fitting in the table, the factor by which it may be multiplied or divided is $\sqrt{3}$ or $\frac{1}{2}\sqrt{3}$. For example, a crystal of a mineral found to contain calcium and phosphorus may give on measurement $c = 0.73\pm$. No corresponding mineral can be found in the lists, but on multiplying by 1.732 the value 1.27 will be obtained, which will be found to correspond to apatite.

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[1] *Z. Kryst. Min.*, **37**, 580, 1903.

HEXAGONAL MINERALS

	c	Page
Breithauptite	0.7471	78
Cancrinite	0.7637	87
Ettringite	0.8170	133
Beryl	0.8643	65
Stuetzite (Tellurblende)	1.0851	339
Milarite	1.1466	241
Eremeyevite (Jeremejewit)	1.1840	189
Tysonite	1.1893	353
Hedyphanite	1.2234	173
Vanadinite	1.2335	357
Svabite	1.2372	333
Mimetite (Mimetesit)	1.2600	242
Apatite	1.2708	50
Pyromorphite	1.2750	280
Penfieldite	1.3450	260
Greenockite	1.4061	166
Wurtzite	1.4163	369
Niccolite (Rothnickelkies)	1.4193	306
Iodyrite (Jodsilber)	1.4196	190

	c	Page
Pyrrhotite (Magnetkies)	1.4291	227
Microsommite (Mikrosommit)	1.4490	241
Nephelite (Nephelin)	1.4530	247
Molybdenite (Molybdänglanz)	1.5400	242
Trimerite	1.6321	349
Loangbanite (Longbanit)	1.6437	211
Covellite (Kupferindig)	1.7200	206
Hanksite	1.7563	169
Connellite	2.0031	102
Cappelenite	2.2349	88
Catapleiite (Katapleit)	2.3605	196
Fluocerite	2.6804	148
Hessenbergite	2.7070	176
Zincite (Rothzinkerz)	2.7846	307
Tridymite	2.8624	349
Spangolite	3.0162	323
Chalcomorphite	3.3067	92

REPRESENTATIVES OF CLASSES WITH DIMINISHED SYMMETRY

CLASS HEMIMORPHIC

Greenockite	1.41 −
Wurtzite	1.41 +
Iodyrite	1.42
Zincite	2.78 +

CLASS PYRAMIDAL

Vanadinite	1.23 +
Mimetite	1.26
Apatite	1.27
Pyromorphite	1.28 −

PERI-HEXAGONAL, (that is, really possessing lower symmetry, but approaching so close to the hexagonal system in angles and habit as to be profitably included here).

Eremeyevite	1.18
Catapleïite	2.36
Hessenbergite	2.71 −

SYN-HEXAGONAL (thru twinning)

Trimerite	1.63
Tridymite	2.86

TRIGONAL MINERALS

	c	Page
(Beyrichite) [variety of millerite]	0.3277	68
Millerite	0.3295	242
Tourmaline (Turmalin)	0.4477	352
Friedelite	0.5470	152
Ferronatrite	0.5528	145
Phenacite (Phenakit)	0.6611	264
Willemite, troostite	0.6695	363
Pyrargyrite (Rothgiltigerz)	0.7880	302
Proustite (Rothgiltigerz)	0.8034	299
Smithsonite (Zinkspath)	0.8062	374
Magnesite	0.8095	225
Rhodochrosite (Manganspath)	0.8183	231
Siderite (Eisenspath)	0.8184	124
Nordenskioeldite	0.8221	250

	c	Page
Soda-niter (Natronsalpeter)	0.8266	247
Dolomite	0.8322	119
Calcite	0.8543	82
Martinite	0.8559	232
Hematolite (Diadelphit)	0.8885	114
Dioptasite	1.0622	118
Chabazite (Chabasit)	1.0860	91
Steenstrupite	1.1100	327
Hamlinite	1.1353	169
Utahite	1.1389	356
Beudantite	1.1842	68
Caryocerite (Karyocerit)	1.1845	196
Svanbergite	1.2365	334
Jarosite	1.2500	187
Alunite	1.2523	35
Melanocerite	1.2554	236

	c	Page
Aphthitalite (Glaserit)	1.2839	158
Bismuth (Wismut)	1.3035	364
Antimony	1.3236	46
Tellurium	1.3300	338
Hematite, specularite (Eisenglanz)	1.3623	123
Corundum (Korund)	1.3636	200
Ilmenite (Titaneisen)	1.3846	343
Graphite	1.3860	165
Pyrochroite	1.4002	280
Arsenic	1.4013	54
Iridium, osmium (Osmiridium)	1.4105	256
Brucite	1.5208	81
Parisite	1.6822	257
Pyrosmalite	1.8380	280
Tachydrite (Tachyhydrit)	1.9000	338
Quartz (Quarz)	1.9051	288
Cinnabarite (Zinnober)	1.9837	377
Eudialyte	2.1116	134
Ice (Eis)	2.4294	122
Chalcophyllite (Kupferglimmer)	2.5540	206
Coquimbite	2.7098	103
Tetradymite	3.1730	340
Chlorite group (Chloritgruppe)	3.3890	95
Chalcophanite	3.5267	92

REPRESENTATIVES OF CLASSES WITH OTHER THAN RHOMBOHEDRAL SYMMETRY

CLASS TRIGONAL-HEMIMORPHIC

Tourmaline	0.45 –
Pyrargyrite	0.79
Proustite	0.80
Ice	2.43

CLASS RHOMBOHEDRAL-TETARTOHEDRAL

Phenacite	0.66
Willemite, troostite	0.67
Dolomite	0.83
Dioptasite	1.06
Ilmenite	1.38 +

CLASS TRAPEZOHEDRAL

Quartz	1.91 –
Cinnabarite	1.98

PERI-TRIGONAL

Chlorite (group)	3.39

BOOK REVIEW

MICROSCOPIC EXAMINATION OF THE ORE MINERALS. W. MYRON DAVY and C. MASON FARNHAM. 154 pages. McGraw-Hill Book Co., New York. $2.50.

This book represents in a sense a new edition of Murdoch's "*Microscopical determination of the opaque minerals*" which was reviewed in this magazine in February, 1917. It represents, however, a great advance over that work, in that the methods originally proposed by Murdoch have been tried out by the two new authors on a large number of specimens, and modifications have been made in accordance with the experience obtained. The principal changes are these: The fine distinctions in color values have been found to be impracticable, and have been discarded as a basis of primary classification. Microchemical methods have been found to vary so much from one specimen to another of the same mineral, or even on different crystal faces on the same specimen, that little dependence is now placed upon their details. The number of reagents has been brought within practicable limits. And blowpipe reactions have been added, because they are of considerable confirmative value. It seems to the reviewer that all of these changes are distinct improvements.

There are also several valuable new features. The chapter on photomicrography of polished sections is unusually full and helpful. There are, in addition to the regular determinative tables, in which the minerals are one by one eliminated until the one under study is identified, a few tables of special properties. In one the colors of about 20 minerals showing others than shades of white or gray in reflected light are listed; in another, there is a similar list of those yielding colored internal reflections; and in a third, a corresponding list of colors of powders. Then there is novel classification of minerals according to their electrical conductivity, the method of determining which is given in the text. While this method is of definite application in but few cases, it is noteworthy that distinctions can be quite certainly made by it between such similar minerals as stromeyerite and argentite, tennantite and tetrahedrite, pentlandite and chalmersite, etc. Finally the chemical elements are separately taken up, and lists of the minerals containing, and the tests applicable to, each of them are presented.

TABLE OF CORRECTIONS (See page 154).

Name	Formulas		Remarks
	Given	Correct	
Aguilarite	$Ag_2S.Ag_2Se$	$Ag_2(S, Se)$	An isomorphous series (Quercigh).
Andorite	$PbAgSb_3S_6$	?	A mixture (Murdoch)
Boulangerite	$3PbS.Sb_2S_3$	$5PbS.2Sb_2S_3$	Sjögren, G.F.F., 1897.
Chilenite	Ag_6Bi	$Ag_{11}Bi$	Contains 85% Ag; calculate it out.
Chiviatite	$Pb_2Bi_2S_{11}$	$Pb_2Bi_6S_{11}$	Obvious when expanded into $2PbS.3Bi_2S_3$.
Delafossite	$CuO.Fe_2O_3$	$Cu_2O.Fe_2O_3$	Rogers, *Am. J. Sci.*, [4], **35**, 290, 1913.
Guanajuatite	Bi_2Se_3	Bi_2SSe_2	In part: Dana, *System*, ed. 6, p. 39.
Guejarite	$Cu_2Sb_4S_7$	$CuSbS_2$	Dana, *Appendix* I, 16, 1899.
Jamesonite	$2PbS.Sb_2S_3$	$5(Pb, Fe)S.3Sb_2S_3$	Schaller, *U. S. G. S. Bull.* **490**, 27, 1911.
Limonite	$2Fe_2O_3.3H_2O$	$FeO(OH)+Aq.$	(Posnjak and Merwin).
Melonite	Ni_2Te_3	$NiTe_2$	Dana, *Appendix* II, 68, 1909.
Pearcite	Ag_9AsS_6	$Ag_{16}As_2S_{11}$	Van Horn and Cook, *Am. J. Sci.*, [4], **31**, 518, 1911.
Polybasite	Ag_9SbS_6	$Ag_{16}Sb_2S_{11}$	Isomorphous with preceding.
Polydymite	Ni_4S_5	Ni_3S_4	Isomorphous with linneite (Zambonini.)
Psilomelane	H_4MnO_5	$MnO_2+X+aq.$	A colloid containing adsorbed substances.
Pyrrhotite	$FeS(S)_x$	$FeS_{1-1.2}$	
Rathite	$Pb(As, Sb)S$	$Pb_3As_4S_9$	Solly and Jackson, *Min., Mag.*, **12**, 287, 1900.
Rezbanyite	$4PbS.5Bi_2S_3$	$2PbS.3Bi_2S_3$	Corresponds to the analyses cited by Dana.
Semseyite	$7PbS.3Sb_2S_3$	$9PbS.4Sb_2S_3$	Spencer, *Min. Mag.*, **12**, 55, 1900.
Sternbergite	$AgFe_2S_3$	$AgFe_2S_{3-4}$	
Sylvanite	$AuAgTe_2$	$AuAgTe_4$	Contains 60% Te; calculate it out.
Tapalpaite	$3Ag_2(S, Te).Bi_2(S, Te)_3$	?	A mixture (Murdoch).
Whitneyite	Cu_9As	?	A mixture (Borgström).

While this work can be recommended highly to the student of determinative mineralogy, there is one direction in which a word of caution is necessary, and that is in connection with mineral formulas. In the first place, it seems to the reviewer confusing and undesirable to give some formulas in condensed and some in expanded form; for instance, on page 63, emplectite is given as $CuBiS_2$, chiviatite as $Pb_2Bi_2S_{11}$, aikinite as $3(Pb, Cu_2)S.Bi_2S_3$ and boulangerite as $3PbS.Sb_2S_3$. Both of these methods of statement have some points in their favor, but the expanded form makes the relationships between minerals so much more obvious that the reviewer would favor it as the one to be followed uniformly. Emplectite would then appear as $Cu_2S.Bi_2S_3$, and chiviatite as $2PbS.3Bi_2S_3$, whereupon it can be readily seen that the first is a meta and the second an acidic compound, those already given in expanded form being ortho compounds.

There is, in addition, a far more serious defect than mere lack of uniformity, namely, a considerable degree of inaccuracy in the statement of formulas. In discussing Murdoch's book, the reviewer took occasion to point out that several formulas were wrongly stated, having been copied from Dana's *System* or other sources without critical consideration; and in the present book not only are the same errors repeated but a number of additional ones perpetrated. While in one sense this is not a serious matter, since the object of the work is primarily to determine minerals,not to establish their formulas, yet the reviewer feels that attention should be called to some of the most noteworthy errors, so that anyone who so desires can make corrections in the text. (See table, page 153.)

If teachers using the book will caution their students concerning the above points, it should prove a valuable aid to the study of mineralogy. E. T. W.

PROCEEDINGS OF SOCIETIES

PHILADELPHIA MINERALOGICAL SOCIETY.

Wagner Free Institute of Science, June 10, 1920

A stated meeting of the Philadelphia Mineralogical Society was held on the above date with the president, Dr. Burgin, in the chair. Fourteen members and one visitor were present.

Messrs. Frankenfield and Biernbaum gave an account of a trip to the French Creek mines and Robeson, on May 29–31, with Messrs. Hagey and Gordon.

Mr. Gordon described the chromite deposits of the State line serpentines in southern Lancaster County. Details were given of the associated minerals, and the possible origin of the deposits.

Samuel G. Gordon, *Secretary.*

NOTES AND NEWS

Mr. Albert B. Peck, Treasurer of the Mineralogical Society of America, leaves the Bureau of Standards the end of this month to become Assistant Professor of Mineralogy in the University of Michigan, Ann Arbor. Correspondence concerning dues of the society, subscriptions, etc., should be directed to his new address.

Dr. Waldemar T. Schaller has returned to his former position in the U. S. Geological Survey, Washington D. C.